

# Copper Soldered Brazed Multilayer Tubes

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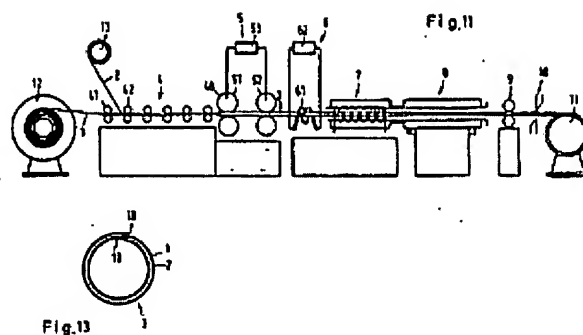
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## Abstract of GB2034206

When making copper-soldered multilayered tubes in which a metal (normally steel) sheet is rolled up and the juxtaposed faces of the tube so formed secured by melting copper thereagainst, a sheet of copper 2 is attached to the sheet of steel 1 in the area thereof that will in the formed tube 3 be facing the other surface of the rolled metal sheet, and extends at least adjacent the outer edge 18 of the metal sheet in the formed tube 3. The copper sheet 2 is preferably firmly attached to the metal sheet 1 before skelping the combined sheets in stage 4 of apparatus providing also resistance heating at 5,



induction heating at 6, a furnace at 7  
and a cooler at 8.

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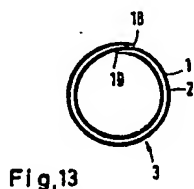
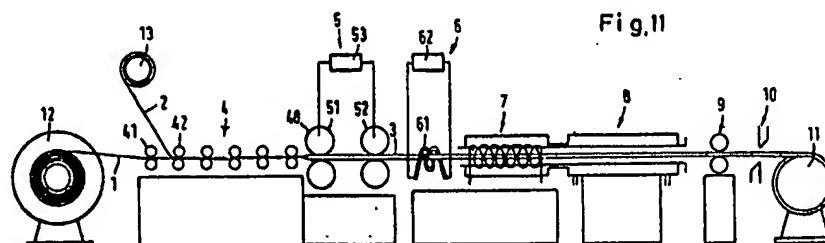
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(54) **Copper Soldered Brazed Multi-layer Tubes**

(57) When making copper-soldered multilayered tubes in which a metal

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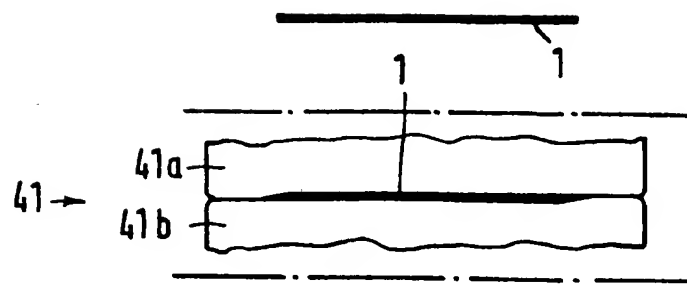


Fig.1

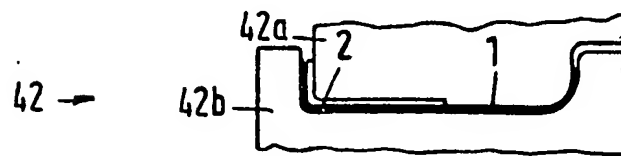


Fig.2

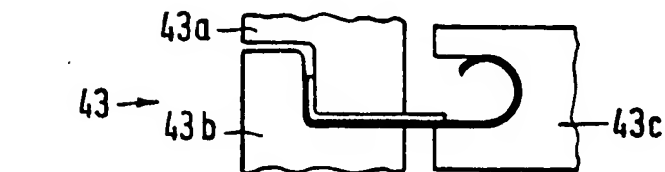


Fig.3

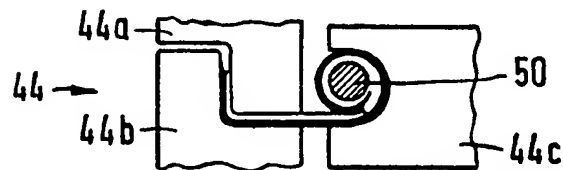


Fig.4

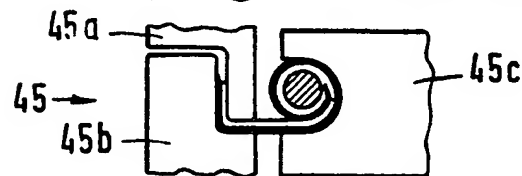


Fig.5

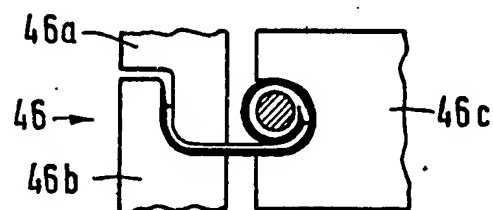


Fig.6

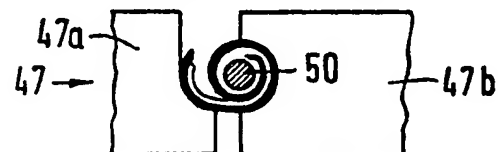


Fig.7

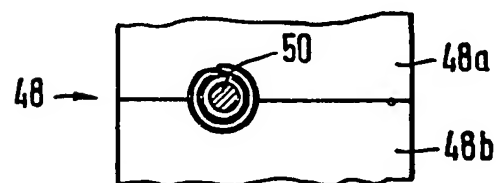


Fig.8



Fig.9

Fig.10

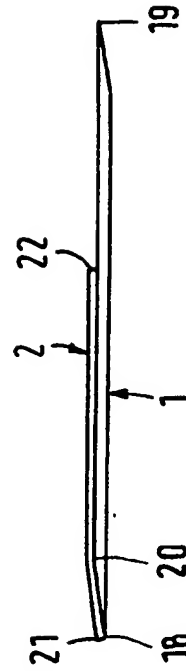
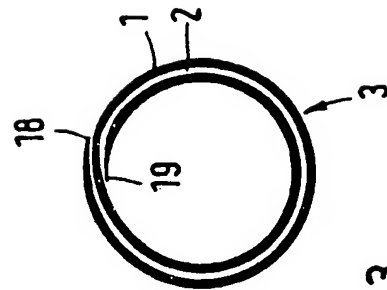
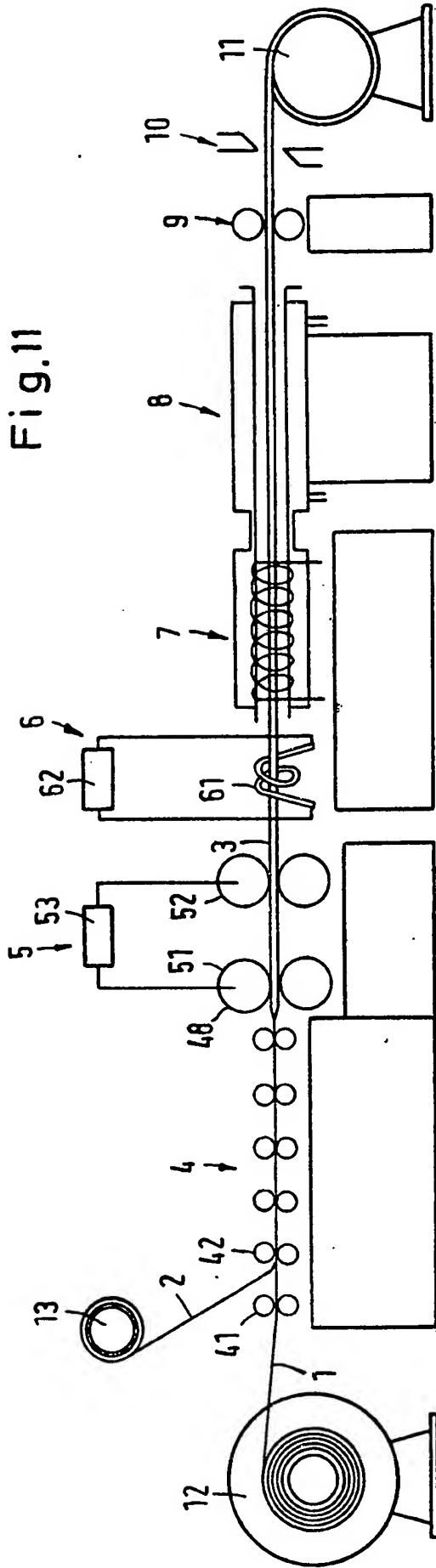


Fig.14

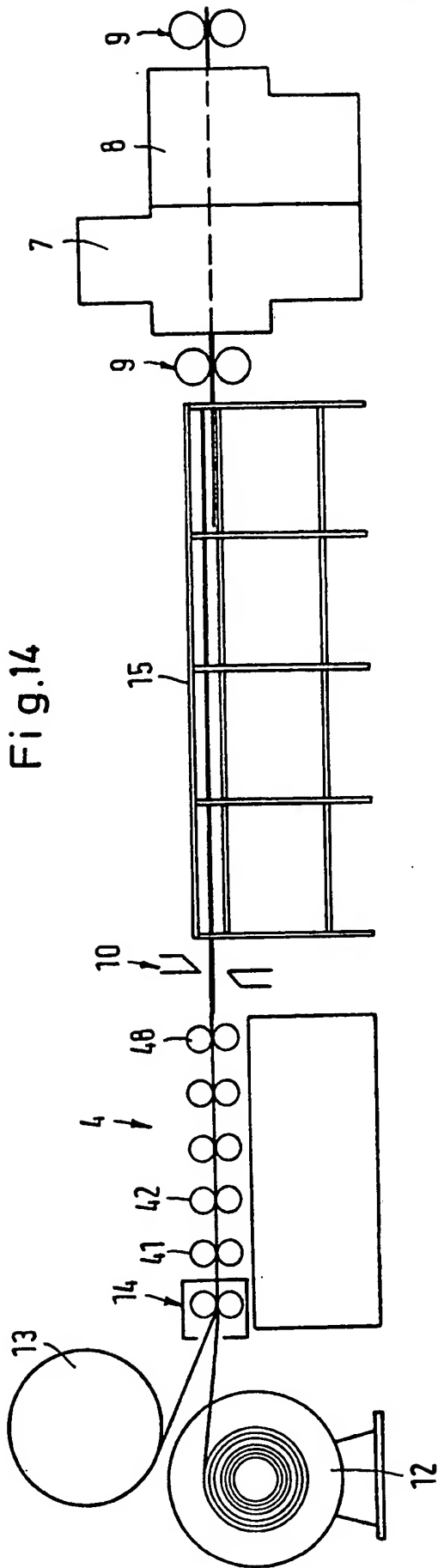
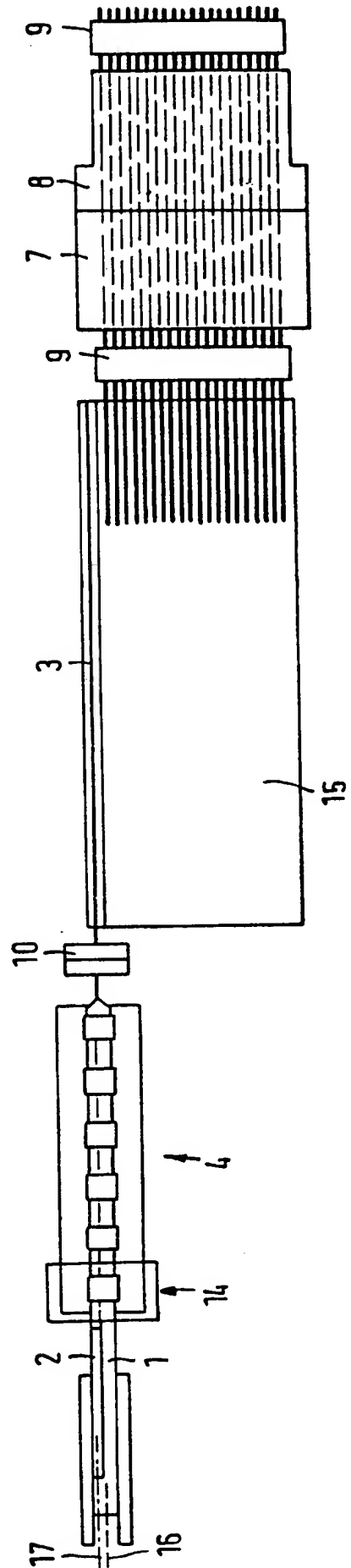


Fig.15



## SPECIFICATION

## Copper-soldered Multilayer Tubes

This invention relates to the production of copper-soldered multilayer tubes. It has particular application to the production of such tubes where a layer of copper is formed between juxtaposed surfaces of a helically rolled metal sheet.

In a known process, a blank or copper-plated iron strip is used as the starting material and rolled to form a multilayer tube. The copper required, or additionally required, is introduced into the inside of the tube in the form of copper wire. The tube member containing this copper wire is then heated, during which capillary action causes molten copper to penetrate between the individual layers of the tube. This process has not proved successful in practice. The copper, which is first distributed over the inner wall of the tube, must first find its way into the gaps between the layers and penetrate into them and, if heat is applied for too long, this may also result in the outer surface of the tube becoming coated with copper.

In another process, multilayer tubes of this kind are made from steel strip copper-plated on one of both sides. Copper-plated steel strip is expensive, and consequently, for economic reasons, it would be advantageous to return to the process first described above, even though it uses a considerable excess of copper in order to ensure that the multilayer tubes are of satisfactory quality. The aim of the present invention is not to produce a tube which is copper-plated on both sides, but merely to provide a means of welding or soldering the juxtaposed metal layers to one another. To this end, the invention provides a process for producing copper-soldered multilayer metal tubes comprising rolling a metal sheet with a sheet of copper in contact therewith, the copper sheet being located against the inner surface of the metal sheet so as to be at least adjacent the outer edge thereof in the formed tube. By using less copper than the processes described above, a considerable economic advantage is achieved.

The invention also provides apparatus for performing the above process, which apparatus comprises means for rolling the metal and copper sheets from stores for each, and means for guiding the respective sheets such that they converge at an acute angle with an edge of the copper sheet at least adjacent an edge of the metal sheet.

Since the rolling up of the steel sheet with the copper sheet, which are normally in strip form, requires a high degree of accuracy in the machinery used, owing to the small thickness of the sheets and particularly because of the normal film-like structure of the copper sheet, and also requires compensation to be carried out by experienced personnel owing to any possible effects of fluctuations in the hardness of the copper strip, the copper sheet is preferably firmly attached to the steel sheet immediately before rolling, normally by plating, and preferably by

65 warm plating.

The invention will now be described by way of example and with reference to the accompanying drawings wherein:

Figures 1 to 10 show various stages of the rolling-up process;

Figure 11 shows a continuously operating apparatus for the production of multilayer tubes;

Figure 12 shows a section through a multilayer tube;

Figure 13 shows a section through a steel strip with a copper strip placed thereon;

Figure 14 shows a side view of a discontinuously operating apparatus for the production of multilayer tubes; and

Figure 15 is a plan view of Figure 14.

Figures 1 to 10 show how a multilayer tube 3 is formed from a steel strip 1 with the introduction of a copper strip 2. The forming of the steel strip 1 according to the Figures is carried out in several deformation stages 41 to 48, with the edges of the strip being chamfered between two rollers 41a, 41b in the first deformation stage 41 (Figure 2). In deformation stage 42, the copper strip 2 has already been put in. Here, the edge of the steel strip which will later form the outer seam is first of all bent round together with the copper strip and the opposite edge of the steel strip is rounded off. The tool parts 42a and 42b are used for this. In deformation stage 43, the steel strip is held in place by the profile rollers 43a and 43b, whilst the profile rollers 43c preform the inner layer. In deformation stage 44, in which the profile rollers 44a and 44b again serve only to hold the strips, the rolling-up process is continued; here, a mandrel 50 can be seen which goes on until deformation stage 48. The multilayer construction can already be clearly seen in deformation stage 45 with the profile rollers 45a and 45b and 45c. In deformation stage 46 a start is made on again removing the bent-over portion in the region of what is to be the outer seam, by means of correspondingly shaped profile rollers 46a and 46b, whilst the profile roller 46c continues the rolling-up process. In deformation stage 47 with the profile rollers 47a and 47b, the rolling-up process is already almost complete, and in deformation stage 48 with the profile rollers 48a and 48b the rolling-up process is finished and a multilayer tube member 3 (Figure 10) is produced. This multilayer tube member 3 is then stabilised in known manner by cold-forming, by drawing it over the mandrel 40 or subjecting it directly to a continuous heat treatment.

The continuous method is shown in Figure 11. Figure 11 shows a strip store 12 for the steel strip 1 and a strip store 13 for the copper strip 2. Here, the copper strip 2 is fed into the rolling-up apparatus 4 between the first deformation stage 41 and the second deformation stage 42. The last stage 48 of the rolling-up apparatus 4 is also one of the sets 51 of contact rollers of a conductive heating apparatus, having a second set 52 of contact rollers associated with it as the second

conductor and also having a transformer 53. In this first heating stage 5 the multilayer tube is heated to about 1100°K and is thus subjected to strain-relief annealing. In a second heating stage 6 with an induction coil 61 and an HF generator 62 the multilayer tube member 3 is heated to soldering temperature which is maintained for a specific period in a continuous-heating furnace 7. In a subsequent cooling area 8 the soldered tube is cooled. Reference numeral 9 designates a set of drive rollers. The finished tube is either cut into individual lengths by means of a cutting apparatus 10 or wound up by means of a coiling apparatus 11.

Figures 12 and 13 each show the steel strip 1 and the copper strip 2 as they pass into the second deformation stage 42 (Figure 12), the copper strip 2 being placed in such a position that the outer edge 21 of the copper strip is located in the region of the edge 18 of the steel strip 1 which will later form the outer seam. The inner edge of the copper strip 22 is at a substantial spacing from the edge 19 of the steel strip which will later form the inner seam, as the copper strip is considerably narrower than the steel strip. Moreover, in the view shown in Figure 12, the outer edge 21 of the copper strip coincides with the edge 18 of the steel strip 1, i.e. it is pulled over the chamfered edge 20.

Figures 14 and 15 show the invention being applied to the discontinuous production method at present in common use, using a plating device 14. The heating means associated with the plating device 14 are not shown.

When a specific length of tubing corresponding to the length of an intermediate depositing area 15 has left the last deformation stage 48 which, in this case, also carries out cold forming, this part of the tube member is divided off and temporarily stored on the intermediate depositing area 15. As soon as a sufficient number of these tube sections has been assembled, they are passed together through the furnace 7 and the subsequent cooling area 8, where the layers are soldered.

Figure 15 also shows that the central axes 16 and 17 of the entry portions of the steel strip 1 and copper strip 2 are offset parallel to each other. Hard drawn copper can be used as the copper strip, which is very easy to guide into the plating apparatus 14. The annealing process during the plating operation then makes the copper soft again.

Furthermore, the apparatus shown in Figures 14 and 15 is particularly characterised in that the integral plating apparatus makes it unnecessary to have relatively heavy guide means for guiding the copper strip during the rolling-up operation. Moreover, this integral plating is also suitable for the continuous method of operation shown in Figure 11.

#### Claims

1. A process for producing copper-soldered

multilayer metal tubes comprising rolling a metal sheet with a sheet of copper in contact therewith, the copper sheet being located against the inner surface of the metal sheet so as to be at least adjacent the outer edge thereof in the formed tube.

2. A process according to Claim 1 including the step of stabilising the tube after formation.

3. A process according to Claim 2 wherein the tube is stabilised by heat treatment.

4. A process according to Claim 3 wherein the heat treatment comprises heating the tube to melt the copper and solder juxtaposed layers of the metal sheet together.

5. A process according to Claim 4 wherein an electrical resistance heating process in which the tube is conductively heated to about 1170°K in a first heat treatment stage and is then inductively brought to the soldering temperature.

6. A process according to any preceding Claim wherein each of the metal and copper sheets is in strip form, the rolling being carried out about an axis parallel to the longitudinal axis of the strip.

7. A process according to any preceding Claim wherein the metal sheet is of steel.

8. A process according to any preceding Claim wherein the width of the copper sheet is substantially half that of the metal sheet.

9. A process according to any preceding Claim wherein the copper sheet is firmly attached to the metal sheet prior to the rolling step.

10. A process according to any preceding Claim wherein the edges of the steel sheet are chamfered by rolling prior to the location of the copper sheet; and wherein, after the location of the copper sheet, a portion of the sheets adjacent the edge which will form the outer edge of the formed tube is bent up approximately at right angles.

11. A process according to Claim 10 wherein the outer edge of the copper sheet coincides with the chamfered edge of the metal sheet.

12. A process for producing copper-soldered multilayer tubes substantially as described herein with reference to and as illustrated by the accompanying drawings.

13. Apparatus for performing a process according to any preceding Claim comprising means for rolling the metal and copper sheets from stores for each, and means for guiding the respective sheets such that they converge at an acute angle with an edge of the copper sheet at least adjacent an edge of the metal sheet.

14. Apparatus according to Claim 13 including a plating apparatus between the point of convergence of the metal and copper sheets and the rolling means.

15. Apparatus for producing copper-soldered multilayer metal tubes substantially as described herein with reference to Figure 11, or Figures 14 and 15 of the accompanying drawings.